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Bootstrap panel Granger-causality between government budget and external deficits for the EU [*]

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Abstract

We investigate the existence of Granger-causality between current account and government budget balances over the period 1970-2007, for different EU and OECD country groupings. We use a panel-data approach based on SUR systems and Wald tests with country specific bootstrap critical values. Our results show a causal relation from budget deficits to current account deficits for several EU countries: Bulgaria, Czech Republic, Estonia, Finland, France, Italy, Hungary, Lithuania, Poland, and Slovakia, along the lines of the so-called twin-deficit relationship. Considering the effective real exchange rate in the SUR system does not substantially alter the results.

Keywords: panel causality tests, budget deficit, external imbalance, real exchange rates, EU, OECD.
JEL Classification Numbers: C23, E62, F32; H62.

[*] The opinions expressed herein are those of the authors and do not necessarily reflect those of the European Central Bank or the Eurosystem.

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1. Introduction

The argument that a budget deficit leads to a current account deficit results from the fact that budget deficit increases the domestic interest rate, and this attracts foreign capital and induces an appreciation of the domestic currency, which in turn leads to an increase in the current account deficit. Such an effect will be more relevant the higher the economy's degree of openness. In practice, the existence of a relationship between the budgetary position of a country and its current account balance naturally needs to be assessed empirically. While several studies have analysed the existence of convergence (or divergence) between the trade and budgetary imbalances on a country basis, only a few studies have taken advantage of the panel econometrics framework, particularly to assess the question of our paper, the existence of Granger causality between the two imbalances.

Empirical analysis does not necessarily provide a positive correlation between the budget balance and the current account balance. Indeed, the existing evidence is rather dissimilar, notably regarding single equation analysis, in the sense that budget balance deteriorations may hardly impinge on the current account position. Overall there is some mixed evidence in favour of a twin-deficits relationship, but this is neither robust nor stable over time, which may imply that fiscal tightening may not diminish the current account deficit. For related empirical analysis see, for instance, Bernheim (1988), Chinn and Prasad (2003), Corsetti and Müller (2006), and Piersanti (2000), while Afonso and Rault (2008) provide for a non-exhaustive overview of studies on this topic.

Moreover, scarcely any evidence relates the specific issue of causality, either unidirectional or bidirectional, between the two imbalances.

Therefore, this paper contributes to the literature with a bootstrap panel analysis of causality between budget balances and external balances for the European Union and OECD countries, during the period 1970-2007. In the approach we use, we allow for cross-country correlation, without the need of pre-testing for unit roots, and such methodology is explained in section two. Section three reports the empirical analysis and section four concludes.

2. Panel Granger causality test methodology

We use a panel data approach developed by Kónya (2006), based on the followings bivariate (here composed of current account balance, *ca*; and budget balance,

bud) or trivariate (here *ca*; *bud*; and real effective exchange rate, *rex*) finite-order vector autoregressive models:

$$\begin{cases} ca_{it} = \alpha_{1,i} + \sum_{j=1}^{p_{1i}} \beta_{1,i,j} ca_{i,t-j} + \sum_{j=1}^{p_{2i}} \gamma_{1,i,j} bud_{i,t-j} + \varepsilon_{1,i,t} \quad t = 1,...,T \quad i = 1,...,N \quad (1a) \\ bud_{it} = \alpha_{2,i} + \sum_{j=1}^{p_{1i}} \beta_{2,i,j} ca_{i,t-j} + \sum_{j=1}^{p_{2i}} \gamma_{2,i,j} bud_{i,t-j} + \varepsilon_{2,j,t} \quad t = 1,...,T \quad i = 1,...,N \quad (1b) \end{cases} \tag{1}$$

and

$$\begin{cases} ca_{it} = \alpha_{1,i} + \sum_{j=1}^{p_{1i}} \beta_{1,i,j} ca_{i,t-j} + \sum_{j=1}^{p_{2i}} \gamma_{1,i,j} bud_{i,t-j} + \sum_{j=1}^{p_{3i}} \eta_{1,i,j} rex_{i,t-j} + \varepsilon_{1,i,t} \quad t = 1,...,T \quad i = 1,...,N \quad (2a) \\ bud_{it} = \alpha_{2,i} + \sum_{j=1}^{p_{1i}} \beta_{2,i,j} ca_{i,t-j} + \sum_{j=1}^{p_{2i}} \gamma_{2,i,j} bud_{i,t-j} + \sum_{j=1}^{p_{3i}} \eta_{2,i,j} rex_{i,t-j} + \varepsilon_{2,i,t} \quad t = 1,...,T \quad i = 1,...,N \quad (2b) \end{cases} \tag{2}$$

where the index i $(i = 1,...,N)$ denotes the country, the index t $(t = 1,...,T)$ the period, j the lag, and p_{1i}, p_{2i} and p_{3i}, indicate the longest lags in the system. The error terms, $\varepsilon_{1,i,t}$ and $\varepsilon_{2,i,t}$, are supposed to be white-noises (i.e. they have zero means, constant variances and are individually serially uncorrelated) and may be correlated with each other for a given country, but not across countries.

Systems (1) and (2) are estimated by the Seemingly Unrelated Regressions (SUR) procedure (since possible links may exist among individual regressions via contemporaneous correlation[1] within equations (1a) and (1b) of system (1); and within equations (2a) and (2b) of system (2)). Then Wald tests for Granger causality are performed with country specific bootstrap critical values generated by simulations.

With respect to system (1) for instance, in country *i* there is one-way Granger- causality running from bud to ca if in the first equation not all $\gamma_{1,i}$ are zero but in the second all $\beta_{2,i}$ are zero; there is one-way Granger-causality from ca to bud if in the first equation all $\gamma_{1,i}$ are zero but in the second not all $\beta_{2,i}$ are zero; there is two-way Granger-causality

[1] This assumption is very likely to be relevant for many macroeconomic time series for EU or OECD countries for which strong economic links exist.

between ca to bud if neither all $\beta_{2,i}$ nor all $\gamma_{1,i}$ are zero; and there is no Granger-causality between ca to bud if all $\beta_{2,i}$ and $\gamma_{1,i}$ are zero[2].

This procedure has several advantages. Firstly, it does not assume that the panel is homogeneous, so it is possible to test for Granger-causality on each individual panel member separately. However, since contemporaneous correlation is allowed across countries, it makes possible to exploit the extra information provided by the panel data setting. Secondly, this approach does not require pretesting for unit roots and cointegration (since country specific bootstrap critical values are generated), though it still requires the specification of the lag structure. This is an important feature since the unit-root and cointegration tests in general suffer from low power, and different tests often lead to contradictory outcomes. Thirdly, this panel Granger causality approach allows the researcher to detect for how many and for which members of the panel there exists one-way Granger-causality, two-way Granger-causality or no Granger-causality.

3. Econometric investigation

3.1 Data

All data for current account balances, general government budget balances and real effective exchange rates are taken from the European Commission AMECO (Annual Macro-Economic Data) database, from the IMF and from the OECD databases.[3] We consider four different country panels: EU15, EU25, Cgroup21, and Cgroup26. The data cover respectively the periods from 1970 to 2007 for the EU15 countries, from 1996 to 2007 for the EU25 countries (i.e. EU27 without Cyprus and Romania, due to short time span availability), from 1970 to 2007 for the Cgroup21 (i.e. EU15 and Australia, Canada, Iceland, Japan, Norway, USA), and from 1987 to 2007 for Cgroup26 (i.e. EU15 and Australia, Canada, Iceland, Japan, Korea, Mexico, New-Zealand, Norway, Switzerland, Turkey, USA). The unbalanced panels within the period 1970-2007 are used for the SUR analysis and Granger-causality testing.

[2] As stressed by Kónya (2006) this definition implies causality for one period ahead. Note that in the trivariate system our focus will remain on the bivariate, one-period-ahead relationship between *ca* and *bud*, so we will not study the possibility of causality at longer horizons, nor the possibility of two variables jointly causing the third one. In other words, *rex* is treated here as an auxiliary variable, and will not be directly involved in the Granger causality analysis.

[3] The AMECO codes are the following ones: .1.0.319.0.ublge, Net lending (+) or net borrowing (-): general government, % of GDP at market prices - excessive deficit procedure). .1.0.310.0.UBCA, Balance on current transactions with the rest of the world (National accounts), % of gross domestic product at market prices.

3.2 Empirical results

We report in Tables 1 and 2 the results for the Granger causality tests, using a bivariate model, respectively from budget balances to current account balances, and from current account balances to budget balances. Those tables present results for the country groups EU15, EU25 and country group CGroup21, as previously defined. Tables 3 and 4 present a similar set of results for Granger causality tests regarding a trivariate model where the effective real exchange rate is also included, while the evidence on statistically significant causality is summarised in Table 5.[4]

Our results uncover the existence of one-way direct Granger causality from the government budget balance to the current account balance, in the bivariate model, for five EU countries: Bulgaria, Czech Republic, Finland, Lithuania, and Slovakia. Out of this set of countries only Finland is not a New Member State (NMS) of the EU. Interestingly, these results hold broadly when a trivariate specification is used, and the effective real exchange rate is considered. In this case, there is also evidence of one-way causality from the budget balances to the current account balances for some additional countries: Estonia, Hungary, Poland, France and Italy.

The fact that the majority of the countries, for which causality from the budget balance to the current account balance is found, are NMS, could be related to the existence of higher interest rates in those countries, high inflows of foreign investment and the appreciation of the respective domestic currencies. Notice that the time span used in the analysis for the NMS covers the period 1996-2007, when these economies followed a catching-up process, notably attracting foreign capital. Moreover, one can conjecture that government budgets also contributed to such process notably by raising internal demand. The evidence of causality from budget balances to the current balances for France and Italy can also be related to relevant budgetary imbalances and higher interest rates during the period used in the sample.

Regarding the existence of causality from the current account balances to the budget balances, there is statistical evidence for a different set of countries; seven from the EU (Austria, Belgium, Ireland, Spain, Czech Republic, Estonia, and Italy), and five other non-EU countries (Australia, Canada, Norway, Iceland, and Mexico). Such

[4] Additional results for the alternative country group CGroup26 are available in the Appendix.

evidence is rather unchanged considering or not the effective real exchange rate in the SUR system.

4. Conclusion

We investigated the existence of Granger-causality between current account and government budget balances, with and without considering the effective real exchange rate, over the period 1970-2007, for several EU and OECD country groupings. We used the panel-data approach of Kónya (2006), which is based on SUR systems and Wald tests with country specific bootstrap critical values.

Our results support the hypothesis of a causal relation from budget deficits to current account deficits for several countries in the EU: Bulgaria, Czech Republic, Estonia, Finland, France, Italy, Hungary, Lithuania, Poland, and Slovakia, along the lines of the so-called twin-deficit relationship. On the other hand, the possibility of a reverse causality is found to be statistically significant for a somewhat different sub-set of OECD countries. Considering the effective real exchange rate in the SUR system does not substantially alter the causality results.

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Table 1a – Granger causality tests from budget balances to current account balances for the EU15 panel (1970-2007), bivariate (CA, BUD) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Austria	-0.1218	1.9729	17.6089	9.9709	7.4661
Belgium	-0.0960	9.0896	22.1543	14.934	10.314
Denmark	0.0091	0.0304	20.6241	9.8911	6.8413
Finland	-0.1801	10.614**	15.3098	10.1621	7.0973
France	-0.0955	2.8023	18.5248	10.9349	7.6774
Germany	0.0474	0.2793	18.4403	10.3510	6.2865
Greece	-0.0146	0.0743	21.1807	13.2739	9.5517
Ireland	-0.0155	0.0491	22.1727	14.7907	9.0896
Italy	-0.0788	3.5063	22.0144	12.6893	8.9588
Luxembourg	-0.1158	0.5750	24.1254	14.7569	9.2305
Netherlands	0.1178	1.6475	19.9103	11.1683	7.1957
Portugal	-0.2672	5.6111	17.8247	9.73810	6.8028
Spain	-0.0780	1.2446	24.8919	13.1370	8.8215
Sweden	-0.0450	1.5160	18.9911	9.98609	6.0055
UK	-0.0025	0.0241	20.2869	11.7501	8.7638

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: BUD does not cause CA.

Table 1b – Granger causality tests from budget balances to current account balances for the EU25 panel (1970-2007, 1996-2007 for NMS), bivariate (CA, BUD) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Austria	-0.1125	2.14762	43.7973	26.2007	16.9958
Belgium	-0.1102	16.1655	56.5276	29.8958	21.162
Bulgaria	-0.3940	46.9707**	66.5806	31.3461	24.4404
Czech Republic	-0.2389	33.5267*	136.764	46.8060	27.8800
Denmark	0.0049	0.01253	42.398	26.3917	20.1636
Estonia	-0.2775	5.90757	86.9449	40.5836	26.5668
Finland	-0.1856	13.3247*	57.5861	29.4169	12.4979
France	-0.1529	10.0342	61.6752	38.4433	26.5120
Germany	-0.0009	0.00176	48.2582	29.6834	20.4028
Greece	-0.0330	0.58713	46.8234	30.1429	20.8347
Hungary	-0.2083	6.38740	82.4022	36.2005	26.1898
Ireland	-0.0338	0.26381	66.935	35.1428	25.4057
Italy	-0.0896	6.66486	38.7987	25.4962	19.6885
Lithuania	-0.5114	25.7777*	99.1208	30.9541	20.0091
Luxembourg	-0.2839	5.46588	113.034	44.2571	28.8312
Latvia	0.1188	0.26786	90.0605	39.9590	23.6354
Malta	0.0358	0.08439	48.6874	23.8899	15.8910
Netherlands	0.0693	0.79242	44.4382	26.0607	16.5963
Poland	-0.1027	2.24052	61.8482	26.5006	19.903
Portugal	-0.3014	8.28391	56.7452	32.3333	20.2260
Spain	-0.0845	1.85501	65.1751	37.3527	24.2919
Slovakia	0.3128	51.0487**	85.6138	31.5580	18.7401
Slovenia	0.0357	0.13581	81.2513	36.751	22.6962
Sweden	-0.0349	1.28510	53.7627	26.3205	18.8356
UK	-0.0082	0.03551	51.0868	23.9186	18.2811

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: BUD does not cause CA.

Table 1c – Granger causality tests from budget balances to current account balances for the Cgroup21 panel (1970-2007), bivariate (CA, BUD) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Australia	0.0987	2.47781	22.3057	12.2437	8.03210
Austria	-0.1610	4.09952	35.7949	21.2883	11.8195
Belgium	-0.0712	8.59699	48.5488	24.7881	16.5793
Canada	0.0543	2.59082	34.0876	19.4779	13.8906
Denmark	0.0238	0.40652	33.4390	19.0888	12.8996
Finland	-0.1540	13.3932*	35.8901	20.3575	13.3019
France	-0.1148	6.44631	41.9754	21.7033	15.3719
Germany	-0.0118	0.02399	31.9677	17.1553	9.69146
Greece	-0.0047	0.01174	35.8497	24.0044	17.3849
Iceland	-0.0950	5.84384	31.2546	14.9175	10.3450
Ireland	-0.0104	0.03865	41.8438	21.6514	15.7192
Italy	0.1649	0.86808	31.7055	18.2363	13.2669
Japan	-0.0656	7.76730	40.9027	20.8168	15.8255
Luxembourg	-0.1858	1.84990	41.3271	23.2244	14.4388
Netherlands	0.1363	2.76275	31.8408	17.2845	11.1476
Norway	0.0731	0.73817	42.6422	22.4094	15.6983
Portugal	-0.2707	7.26021	35.1842	21.9296	13.7191
Spain	-0.0832	1.57094	50.8964	24.5849	17.0351
Sweden	-0.0465	1.82871	34.6576	17.3003	12.4461
UK	0.0376	0.67360	33.3215	19.2197	12.8902
USA	-0.1016	7.62654	27.2683	14.5142	9.69367

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: BUD does not cause CA.

Table 2a – Granger causality tests from current account balances to budget balances for the EU15 panel (1970-2007), bivariate (CA, BUD) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Austria	0.2210	13.4208**	17.5712	10.4197	7.9679
Belgium	0.2871	13.7078**	19.7167	13.5886	9.7279
Denmark	0.0881	1.31955	18.1164	12.3046	9.2414
Finland	0.0671	1.35295	27.2978	14.5593	10.271
France	-0.064	1.39614	23.4105	12.7198	8.7197
Germany	0.1271	3.60793	18.5508	10.6659	8.0736
Greece	0.0294	0.27339	23.4356	13.4522	9.7064
Ireland	0.1696	12.7463	20.4963	14.3203	12.831
Italy	0.1876	2.84178	15.5296	9.48713	7.0580
Luxembourg	-0.0011	0.00816	16.4516	8.72485	6.2463
Netherlands	0.0923	1.61837	19.0365	12.6034	8.6502
Portugal	0.0753	2.72063	20.4930	12.1438	8.6698
Spain	-0.1470	13.7229**	21.7501	12.8443	8.8471
Sweden	0.1281	2.84636	25.2514	12.8172	9.8969
UK	-0.0120	0.01126	19.3643	12.5416	7.7915

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: CA does not cause BUD.

Table 2b – Granger causality tests from current account balances to budget balances for the EU25 panel (1970-2007, 1996-2007 for NMS), bivariate (CA, BUD) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Austria	0.2477	27.0823**	51.4192	27.0725	18.8457
Belgium	0.3395	22.9939*	60.7129	33.9597	22.8654
Bulgaria	-0.1214	6.53548	81.7843	43.1901	29.6061
Czech Republic	1.1697	280.073***	85.5306	50.0388	37.0912
Denmark	0.0937	2.05593	65.1437	36.1363	24.1356
Estonia	-0.1068	10.3509	55.9677	27.9963	18.7136
Finland	0.0805	2.91939	67.3981	36.3683	24.804
France	-0.0055	0.01425	68.8777	37.0922	25.8136
Germany	0.1413	6.81759	53.1155	29.7250	20.3780
Greece	0.0226	0.20797	61.2141	33.9221	23.2058
Hungary	0.2563	21.7206	76.0673	40.0727	27.3466
Ireland	0.1860	17.8076	69.9690	36.2288	24.8724
Italy	0.2078	6.81759	56.3698	30.9851	21.3829
Lithuania	0.1266	8.13473	58.6948	27.3797	17.9579
Luxembourg	0.0464	1.08615	49.6066	25.7339	17.4109
Latvia	0.0025	0.07720	52.4671	25.8900	17.0370
Malta	0.1703	7.68076	73.7735	35.1349	23.2672
Netherlands	0.0907	3.29045	60.7695	33.2827	22.7975
Poland	0.2553	6.49466	66.5200	35.5261	23.944
Portugal	0.0889	5.49646	55.3221	28.6983	19.2603
Spain	-0.1721	34.5352**	62.9539	33.0983	22.6032
Slovakia	0.0635	0.19904	80.6109	45.4936	30.8208
Slovenia	0.0789	1.44234	147.694	71.0913	48.2888
Sweden	0.2082	9.97688	65.2674	36.0752	24.7731
UK	0.2477	1.00451	61.465	30.7354	21.4484

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: CA does not cause BUD.

Table 2c – Granger causality tests from current account balances to for the Cgroup21 panel (1970-2007), bivariate (CA, BUD) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Australia	-0.2475	14.9762*	38.4361	22.9415	13.7611
Austria	0.2222	19.5541**	31.2584	17.2527	12.0923
Belgium	0.3033	18.1000	40.3216	27.5948	19.7326
Canada	0.2545	20.8322*	43.2188	24.4248	19.5489
Denmark	0.0624	0.70461	41.6768	22.4323	16.6925
Finland	0.0562	1.18696	42.9425	25.2027	18.3524
France	-0.0112	0.05611	34.2874	20.4964	15.2943
Germany	0.0746	1.63140	24.0558	15.5602	10.4867
Greece	0.0300	0.35163	43.7234	19.7262	14.4036
Iceland	0.2236	7.22785	26.6495	15.3333	11.7551
Ireland	0.1769	20.2250*	55.4867	27.1829	18.8700
Italy	-0.1497	33.2625***	30.3124	16.9951	11.8789
Japan	0.1323	0.98644	37.6086	20.1220	13.3431
Luxembourg	0.0352	0.63578	39.3196	16.8312	12.0791
Netherlands	0.0590	0.87512	29.2102	16.6555	12.4642
Norway	0.2238	43.9796**	46.2584	23.4637	15.2612
Portugal	0.0330	0.76715	33.6022	19.7013	12.0043
Spain	-0.1481	15.3984*	31.0567	20.1789	13.2209
Sweden	0.1228	2.94902	42.7628	21.6023	16.4864
UK	-0.0863	0.64471	30.3871	18.1017	12.9953
USA	0.0641	1.85154	31.0897	21.2929	15.9826

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: CA does not cause BUD.

Table 3a – Granger causality tests from budget balances to current account balances for the EU15 panel (1970-2007), trivariate (CA, BUD, REX) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Austria	-0.1026	0.5097	15.0294	9.76541	7.2724
Belgium	-0.0850	5.7613	24.4734	14.9480	8.7617
Denmark	0.0095	0.0330	18.7587	9.20970	7.0200
Finland	-0.1755	8.6874*	16.0793	8.94410	6.8819
France	-0.1275	4.9532	16.1329	10.6111	8.0132
Germany	0.0139	0.0244	16.7405	10.1613	7.0988
Greece	0.0650	0.9785	21.2359	12.6377	8.6260
Ireland	-0.0333	0.2197	21.5234	13.5478	10.205
Italy	-0.1052	5.3060	14.5762	8.51481	6.7535
Luxembourg	-0.0979	0.2955	24.4612	11.7918	7.7393
Netherlands	0.1035	1.2904	20.7780	9.73091	6.7232
Portugal	-0.2829	5.8426	15.6555	10.3215	7.8092
Spain	0.0357	0.1765	19.3505	12.3120	8.0825
Sweden	-0.0628	2.5410	15.8202	7.81911	5.4434
UK	0.0264	0.2095	17.8724	9.12395	6.2212

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: BUD does not cause CA.

Table 3b – Granger causality tests from budget balances to current account balances for the EU25 panel (1970-2007, 1996-2007 for NMS), trivariate (CA, BUD, REX) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Austria	-0.0886	0.5542	41.3010	28.9222	19.2597
Belgium	-0.1080	12.467	52.6592	27.4962	17.2239
Bulgaria	-0.3604	30.132*	97.1317	46.9680	29.8037
Czech Republic	-0.2999	48.945**	94.0543	42.4680	22.0298
Denmark	0.0077	0.0312	41.7944	23.9718	17.2537
Estonia	-0.5042	24.019*	87.5025	30.0444	20.2046
Finland	-0.2016	14.779*	60.0785	30.4698	14.3326
France	-0.1610	11.020	52.2093	26.1209	18.8321
Germany	-0.0325	0.2748	46.2398	27.5085	18.8700
Greece	0.0209	0.1388	38.2880	22.4442	16.1207
Hungary	-0.4590	25.318*	49.8247	30.8239	19.858
Ireland	-0.0525	0.6206	46.1688	25.7545	18.2065
Italy	-0.1011	6.9862	32.5002	20.6835	14.6002
Lithuania	-0.6572	58.804**	233.146	45.1415	23.5948
Luxembourg	-0.2871	3.7869	45.0295	26.2708	19.1888
Latvia	-0.0694	0.1149	67.0000	35.8248	27.0371
Malta	-0.2203	0.9705	50.9769	31.7786	21.2535
Netherlands	0.0697	0.7486	40.7907	23.8351	16.1974
Poland	-0.2310	25.698*	65.6607	27.4022	19.0187
Portugal	-0.2760	6.4198	34.2515	23.7551	17.9555
Spain	0.0334	0.1867	22.6425	12.9124	9.4359
Slovakia	0.2889	44.200**	95.2704	31.8745	15.8232
Slovenia	0.0376	0.0911	89.2911	35.7054	19.0756
Sweden	-0.0313	0.9367	54.5721	24.4355	16.4764
UK	-0.0011	0.0054	53.1380	21.5314	16.3642

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: BUD does not cause CA.

Table 3c – Granger causality tests from budget balances to current account balances for the Cgroup21 panel (1970-2007), trivariate (CA, BUD, REX) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Australia	0.1099	3.1356	23.3271	13.7527	9.8809
Austria	-0.0752	0.3189	36.7478	18.3407	11.8442
Belgium	-0.0713	6.5864	37.2762	22.5548	14.6701
Canada	0.0821	4.9609	32.2149	19.9396	13.216
Denmark	-0.0045	0.0149	29.2877	16.6354	12.2823
Finland	-0.1641	11.686*	34.7298	15.2402	11.1207
France	-0.1647	12.163*	27.7623	17.0333	10.8271
Germany	-0.0330	0.1901	25.0917	12.7338	8.8758
Greece	0.0531	0.8846	33.6928	17.3848	12.7044
Iceland	-0.1230	8.3372	28.1537	13.5040	8.8506
Ireland	-0.0458	0.6667	32.9734	21.7877	15.2148
Italy	0.2256	1.3431	35.0153	18.2313	12.5074
Japan	-0.0430	2.6465	42.5990	21.2979	13.5377
Luxembourg	-0.1024	0.4008	24.8104	14.4957	11.1564
Netherlands	0.1233	2.1646	27.7951	12.5450	9.8458
Norway	0.0683	0.7042	32.0350	17.1179	11.8143
Portugal	-0.2600	5.7540	34.4611	18.1117	11.9898
Spain	0.0760	0.8992	15.6560	9.01711	6.8910
Sweden	-0.0484	1.8375	32.9308	19.4626	11.2882
UK	0.0622	1.4544	28.3879	15.3956	9.7831
USA	-0.0933	5.3514	20.8200	14.2052	9.6816

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: BUD does not cause CA.

Table 4a – Granger causality tests from current account balances to budget balances for the EU15 panel (1970-2007), trivariate (CA, BUD, REX) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Austria	0.3105	23.0243**	23.9905	13.1451	8.6418
Belgium	0.3299	10.9965*	18.9138	13.7146	8.4004
Denmark	0.2099	4.19445	21.0953	11.4226	8.5290
Finland	-0.1123	3.00617	23.3950	14.8938	10.492
France	-0.0328	0.32184	21.7152	13.9151	9.5126
Germany	0.1021	1.73900	16.9003	10.2410	7.2934
Greece	0.1403	6.58474	20.7480	12.2177	7.9267
Ireland	0.1476	9.74008*	26.8709	13.1867	9.6735
Italy	0.1957	2.68075	19.8949	9.27920	6.7191
Luxembourg	0.0304	0.32526	18.5223	9.44810	6.4958
Netherlands	0.1237	2.38242	17.6683	11.3519	8.0518
Portugal	0.0961	2.81910	16.6935	11.2037	6.9183
Spain	-0.2414	21.1316***	19.2807	12.3846	7.0909
Sweden	0.1363	1.16733	20.6931	12.7806	8.8891
UK	-0.0366	098063	20.4702	9.2977	6.6076

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: CA does not cause BUD.

Table 4b – Granger causality tests from current account balances to budget balances for the EU25 panel (1970-2007, 1996-2007 for NMS), trivariate (CA, BUD, REX) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Austria	0.3050	29.04767**	42.7471	24.1836	16.5038
Belgium	0.4419	24.14173**	44.5815	22.9847	16.0922
Bulgaria	0.1012	4.921740	83.4110	47.5966	32.8049
Czech Republic	1.0058	189.0767***	81.9272	47.2400	33.9191
Denmark	0.3214	12.06610	45.6130	23.8499	16.3219
Estonia	-0.4970	63.51770**	76.1912	40.1880	26.3485
Finland	-0.0743	1.722820	52.7297	29.5373	19.9807
France	0.0400	0.655909	56.3607	29.6258	20.3324
Germany	0.0959	2.407945	48.4721	26.2896	17.8287
Greece	0.1639	12.14297	40.1092	21.0431	14.6201
Hungary	0.0796	2.062641	72.1796	33.6867	22.3112
Ireland	0.1083	6.430092	48.7012	26.8627	18.9128
Italy	0.2795	10.92041	48.7678	26.3480	17.9711
Lithuania	0.1714	7.143020	76.0781	36.7169	23.5873
Luxembourg	0.0540	1.890863	46.5044	24.769	15.9973
Latvia	-0.1244	14.67002	65.3116	31.6509	20.1739
Malta	0.1228	4.605291	64.0031	29.6390	19.2660
Netherlands	0.1049	2.800345	48.6511	25.6354	17.4253
Poland	0.1196	1.117126	80.1080	41.3626	28.829
Portugal	0.1200	7.354238	49.0942	25.1161	17.5189
Spain	-0.2368	30.73627**	50.2643	27.6916	19.2412
Slovakia	-0.5469	10.61160	84.9531	46.0851	30.9879
Slovenia	-0.1804	27.24954	109.768	47.6334	29.6841
Sweden	0.1536	2.100697	61.2883	32.0168	22.1453
UK	-0.1172	1.747915	49.2910	25.5140	17.4726

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: CA does not cause BUD.

Table 4c – Granger causality tests from current account balances to budget balances for the Cgroup21 panel (1970-2007), trivariate (CA, BUD, REX) models

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Australia	-0.2085	8.1858	33.6979	16.6226	10.5763
Austria	0.3374	45.209***	30.0088	17.1039	12.9309
Belgium	0.3755	17.004**	26.8670	14.7324	9.5865
Canada	0.1627	6.5972	42.2218	21.7255	15.0578
Denmark	0.2481	7.0469	35.2888	16.9941	10.532
Finland	-0.0810	1.8025	36.4320	21.1240	15.4358
France	0.0212	0.1746	30.4258	18.2855	12.3405
Germany	0.0324	0.2568	26.4979	17.2037	11.9593
Greece	0.1410	7.8410	30.2080	16.4601	11.2862
Iceland	0.2060	4.3591	24.8221	14.9135	10.6421
Ireland	0.1521	15.520*	36.7788	20.5024	13.7037
Italy	-0.1605	29.502***	29.1906	13.2997	9.52901
Japan	0.1759	1.3964	28.5556	17.5338	11.8866
Luxembourg	0.0399	0.8494	33.1472	16.4251	12.0154
Netherlands	0.0868	1.5917	26.0322	14.9633	11.0924
Norway	0.1954	36.086***	35.9175	21.9975	13.9159
Portugal	0.0562	1.3120	35.1937	20.8754	12.5872
Spain	-0.2598	27.506**	33.6013	20.1821	14.6272
Sweden	0.0616	0.3297	35.1872	21.9195	16.0852
UK	-0.1128	1.2055	27.8089	15.8205	12.1298
USA	-0.0139	0.0740	27.6474	17.1973	12.1993

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: CA does not cause BUD.

Table 5 – Summary of results

a) Bivariate models (CA, BUD)

Panel	Budget balance ⇒ Current account balance	Current account balance ⇒ Budget balance
EU15, 1970-2007	Finland	Austria, Belgium, Spain
EU25, 1970-2007; NMS, 1996-2007	Bulgaria, Czech Republic, Finland, Lithuania, Slovakia	Austria, Belgium, Czech Republic, Spain
CGroup 21, 1970-2007	Finland	Australia, Austria, Canada, Ireland, Italy, Norway, Spain
CGroup 26, 1970-2007; 1987-2007 for KOR, MEX, NZ, SZ, TUR		Austria, Canada, Ireland, Iceland, Mexico, Norway, Spain

b) Trivariate models (CA, BUD, REX)

Panel	Budget balance ⇒ Current account balance	Current account balance ⇒ Budget balance
EU15, 1970-2007	Finland	Austria, Belgium, Ireland, Spain
EU25, 1970-2007; NMS, 1996-2007	Bulgaria, Czech Republic, Estonia, Finland, Hungary, Lithuania, Poland, Slovakia	Austria, Belgium, Czech Republic, Estonia, Spain
CGroup 21, 1970-2007	Finland, France	Austria, Belgium, Ireland, Italy, Norway, Spain
CGroup 26, 1970-2007; 1987-2007 for KOR, MEX, NZ, SZ, TUR	Italy	Austria, Belgium, Iceland, Mexico, Norway, Spain

Appendix

Table A1 – Granger causality tests from budget balances to current account balances for the Cgroup26 panel (1970-2007, 1987-2007 for KOR, MEX, NZ, SWZ, TUR), bivariate models (CA, BUD)

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Australia	0.0396	0.5593	55.1075	24.0324	17.2201
Austria	-0.1140	2.3616	60.1008	34.2755	20.7356
Belgium	-0.0809	12.297	82.2568	53.3986	37.0357
Canada	0.0710	5.7590	83.3562	43.4864	27.5492
Denmark	0.0214	0.3859	67.2480	41.4165	29.5077
Finland	-0.1403	14.848	72.9308	43.6375	28.6703
France	-0.1224	8.5999	62.6613	37.1268	26.6512
Germany	0.0002	0.0010	67.9075	39.5944	25.9632
Greece	0.0069	0.0307	71.6463	37.1319	24.8612
Iceland	0.1544	1.0854	73.5574	42.9189	31.0736
Ireland	0.0050	0.0109	106.071	55.2984	40.8419
Italy	-0.1225	10.774	42.8348	28.4209	20.8929
Japan	-0.0715	11.271	92.8476	46.2855	33.4315
Korea	0.7546	22.235	84.8402	46.7340	30.7200
Luxembourg	-0.1490	1.9725	107.543	50.5564	37.1407
Mexico	-0.0023	0.0028	84.5325	43.2410	25.2736
Netherlands	0.0787	1.2828	69.1598	34.9397	23.0821
New Zealand	-0.0400	0.2651	53.5919	34.5824	25.0705
Norway	0.1024	1.8895	75.7452	44.1814	29.8283
Portugal	-0.2393	6.0951	89.1114	29.9609	22.9827
Spain	-0.0997	3.4363	74.7362	41.9158	32.7571
Sweden	-0.0607	3.3654	56.6143	32.9059	24.2414
Switzerland	0.0222	0.0313	76.5486	41.2231	26.9195
Turkey	0.0264	0.2196	77.3461	36.9589	25.6126
UK	0.0162	0.1479	70.4420	33.9604	24.3903
USA	-0.1024	10.816	56.0607	28.6441	24.0032

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: BUD does not cause CA.

Table A2 – Granger causality tests from current account balances to budget balances for the Cgroup26 panel (1970-2007, 1987-2007 for KOR, MEX, NZ, SWZ, TUR), bivariate models (CA, BUD)

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Australia	-0.2295	18.8500	95.5523	51.4872	33.7901
Austria	0.2078	25.2311*	68.9876	31.1929	20.0492
Belgium	0.3264	27.2304	68.6407	41.3540	29.6090
Canada	0.2546	39.4861*	120.248	55.5246	42.0624
Denmark	0.1170	3.82211	84.5530	51.3559	34.5897
Finland	0.1194	8.21755	83.7567	49.5890	37.4456
France	0.0214	0.26295	86.9724	56.5540	37.8702
Germany	0.1179	6.32867	68.7082	41.2797	28.7122
Greece	-0.0169	0.13518	79.0020	45.0788	29.7468
Iceland	-0.1497	48.3506**	59.1738	34.3845	19.0350
Ireland	0.1672	29.4512*	103.256	51.5720	24.9189
Italy	0.1804	6.04202	59.7671	32.4693	22.9949
Japan	0.0723	0.42799	80.7655	43.5128	26.9547
Korea	0.0399	2.73832	60.2762	37.0375	23.0391
Luxembourg	0.0295	0.69214	64.1683	31.9305	20.7906
Mexico	-0.7699	63.1454**	87.9046	45.8730	30.1348
Netherlands	0.0144	0.07535	58.1079	31.6530	24.1077
New Zealand	-0.0370	0.07535	75.1239	40.8693	24.0152
Norway	0.2086	59.3459**	78.9056	45.2422	31.2220
Portugal	0.0234	0.57682	71.8161	49.2144	27.7985
Spain	-0.1473	17.8080*	58.0656	35.7859	17.0820
Switzerland	0.0327	5.93418	100.060	54.7575	38.7311
Sweden	0.1848	8.01904	91.8010	50.4905	33.3648
Turkey	-0.0532	0.91908	63.1078	30.6742	22.9395
UK	-0.1289	2.54084	70.3820	43.4899	29.6069
USA	0.0584	1.94511	78.3607	40.4462	27.5752

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: CA does not cause BUD.

Table A3 – Granger causality tests from budget balances to current account balances for the Cgroup26 panel (1970-2007, 1987-2007 for KOR, MEX, NZ, SWZ, TUR), trivariate models (CA, BUD, REX)

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Australia	0.0556	1.1275	39.9353	22.4305	15.9843
Austria	-0.0735	0.3612	43.2500	30.7355	19.8910
Belgium	-0.0659	6.2091	59.5578	32.6318	21.5883
Canada	0.0966	8.7609	46.6443	31.1869	21.7066
Denmark	0.0050	0.0230	45.9528	26.1360	17.6729
Finland	-0.1393	10.608	59.4901	33.9534	23.4073
France	-0.1717	15.860	50.5747	30.6981	19.8585
Germany	-0.0593	0.7399	47.7725	25.3301	18.4327
Greece	0.0691	1.7506	42.0274	25.6047	18.2143
Iceland	0.2433	2.1268	54.3961	29.8410	21.7062
Ireland	-0.0054	0.0121	54.9843	35.4853	25.2352
Italy	-0.1496	13.736*	48.0327	18.9687	13.4259
Japan	-0.0588	6.3269	59.8752	38.7450	27.3470
Korea	0.6313	11.814	56.7566	37.1544	22.7816
Luxembourg	-0.0884	0.4841	64.5009	35.8000	24.8792
Mexico	-0.0809	2.8496	35.9138	23.3197	16.4050
Netherlands	0.1226	2.9266	54.0106	24.9500	16.3664
New Zealand	-0.0474	0.3156	48.2675	24.3151	16.1930
Norway	0.0996	1.8809	52.3565	32.7913	22.1626
Portugal	-0.2316	5.0119	57.250	27.0146	19.3697
Spain	0.0403	0.3199	24.9863	17.4461	11.2073
Sweden	-0.0468	1.8116	55.1535	29.6352	18.7367
Switzerland	0.0222	0.0862	67.8427	34.4097	23.3951
Turkey	0.0148	0.0455	48.7912	32.4513	23.1931
UK	0.0302	0.4363	43.7328	25.7231	16.3385
USA	-0.1095	10.538	41.9155	21.0433	14.6832

Notes:`a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: BUD does not cause CA.

Table A4 – Granger causality tests from current account balances to budget balances for the Cgroup26 panel (1970-2007, 1987-2007 for KOR, MEX, NZ, SWZ, TUR), trivariate models (CA, BUD, REX)

Country	Estimated coefficient	Test Statistic	Bootstrap critical values		
			1%	5%	10%
Australia	-0.1655	8.7104	54.1639	33.0308	21.8734
Austria	0.3048	55.245***	55.1421	32.6740	21.5371
Belgium	0.3710	22.438*	48.8503	28.0876	20.4877
Canada	0.1211	6.0820	61.8913	43.0496	31.1421
Denmark	0.2154	10.419	57.0436	37.0555	22.8651
Finland	-0.0982	3.9222	59.0244	39.7540	27.8795
France	0.0382	0.7961	73.0054	38.2013	27.4366
Germany	0.0026	0.0022	56.5285	27.5070	18.5895
Greece	0.0945	4.7533	60.4405	28.3771	17.4979
Iceland	-0.1654	45.543***	36.6003	19.4342	14.9104
Ireland	0.1381	16.060	61.6908	36.4965	24.3072
Italy	0.1870	4.8632	42.7536	27.0309	20.5896
Japan	0.0624	0.2977	54.0851	30.8936	19.7079
Korea	0.0229	0.8137	39.1036	23.4657	16.4832
Luxembourg	0.0441	1.5859	47.2989	29.7339	18.2610
Mexico	-0.7731	47.226**	76.2906	35.8339	23.9523
Netherlands	0.0246	0.1776	53.9507	28.1421	18.8478
New Zealand	-0.0393	0.7025	57.8516	33.4878	22.5199
Norway	0.1742	42.861**	75.1211	34.7805	25.6494
Portugal	0.0288	0.4896	40.5507	26.7923	18.4358
Spain	-0.2841	41.782**	61.6380	30.4673	22.0187
Sweden	0.0431	0.1888	60.4607	40.2029	30.8044
Switzerland	0.0472	10.632	73.4669	38.3930	26.6594
Turkey	0.0134	0.0408	40.6889	25.3480	17.3184
UK	-0.0918	1.7038	59.8360	27.7520	20.7588
USA	-0.0013	0.8460	45.7550	29.4962	22.0389

Notes: a) ***, ** and * denotes significance at the 1%, 5% and 10% levels, respectively.
b) H_0: CA does not cause BUD.